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Manufacturing *Kairos:* Opportunity and Ethos in Emerging Biotechnologies

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ABSTRACT: Building on previous work in ethos and *kairos* in science, this paper examines the role of *kairos* construction through ethos appeals in digital media. Using a case study of a biotech corporation and its public communication through digital media, I argue that new media amplify the shifting nature of *kairos.*

KEYWORDS: bioscience, biotechnology, digital media, disease, ethos, genetic engineering, *kairos*, public communication, rhetoric of science, Twitter

1. INTRODUCTION

The concept of discourse as a manufacturing tool is a provocative one, and one that lends itself easily to rhetorical studies. This concept has so far been employed by Leah Ceccarelli (2011) in a comparison of three case studies of manufactured scientific controversy, and by Holly Stocking and Lisa Holstein (2009) in their study of journalistic uses of ignorance claims for manufacturing doubt.

These two studies included cases of manufacturing uncertainty and controversy in the public arena and have been successfully stirred through, as Ceccarelli (2011) explains, "exploiting balancing norms and making appeals to values such as open-mindedness, freedom of inquiry, and fairness" (p. 212). In the cases examined by Ceccarelli (AIDS dissent, global warming, and intelligent design), ethos of the rhetor or the ethos of the scientific communities at hand also plays a role in the ability to manufacture a controversy. For example, the politicians against global warming attacks mainstream scientists as having a "leftist agenda" and Intelligent Designers strengthen their proponents' ethos, characterizing them as maverick scientists on the cutting edge of a revolutionary paradigm shift.

The role of ethos in science, normal or controversial, has been well-studied by rhetoricians. S. Michael Halloran (1984) argues how the specific ethos construction offered in Watson and Crick's seminal paper on the structure of DNA contributed their quick uptake in the field of molecular biology. Later, Carolyn R. Miller (1992) responds to Halloran's argument by arguing that it was in fact Watson and Crick's *kairos* that enabled their gutsy and brash ethos. Their ethos, she argues, was the fitting response to their specific kairotic moment and conceptual space that was offered by their contextual situation. This is not to say that their ethos was passive and did not have any rhetorical effect on the situation. The way in which Watson and Crick responded to their situation, while suitable and fitting, amplified the importance of the situation as a whole and the value and suitability of their contribution, specifically.

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The landscape of science communication, especially public communication, has changed drastically since Watson and Crick's seminal publication. With the increased use of various digital media by scientific organizations, enabling them to directly interact with various audiences, not only is ethos construction essential across these media, but the construction of the situation itself, the *kairos*, is essential as well. Digital media enable a continuous stream of interaction rather than a one-time published manuscript, and thus a continuous stream of ethos construction. In addition, the continuous stream of communication necessitates a reminder of the specific situation to which the organization is responding, thus a continuous construction of the kairotic moment.

This study builds Halloran (1984) and Miller's (1992) notions of ethos and *kairos* in science, expanding these ideas to digital media. This paper attempts to understand the role of ethos in *kairos* construction through the public communication of science in digital media. Building on the work of S. Michael Halloran and Carolyn R. Miller, I analyze how their analyses of ethos and *kairos* in bioscience apply to the new industry of biotechnology. By considering the public communication strategies of one for-profit organization, communicating simultaneously to interested communities, potential customers, potential investors, and their broader scientific community, this investigation raises questions concerning what is the appropriate and ethically-minded ethos for these audiences of differing interests.

2. ETHOS AND *KAIROS* IN BIOSCIENCE

Citing Edwin Black, Halloran (1984) describes the general function of ethos in the sciences:

> While the specific beliefs [the scientific communities] hold—the logos of the discipline—may be crucial to a scientific community, their identity as a community may rest equally on "stylistic proclivities and the qualities of mental life of which those proclivities are tokens," that is, on what I am calling ethos. (p. 71)

Ultimately, Halloran argues that the unique ethos constructed in Watson and Crick's article is what made their argument so pivotal in the field, more so than the more timid and understated claims of Oswald Avery, who was the first to write about the significance of DNA. Along with their model of DNA, Halloran (1984) argues that Watson and Crick offer an alternative sense of "the scientist speaking" (p. 75). More specifically:

> In offering their model of DNA to the scientific world, they simultaneously offered a model of the scientist, of how he ought to hold ideas and present them to his peers. I believe that this ethical aspect of Watson and Crick's work contributed to the speed with which their model of DNA gained prominence as a theory. (Halloran, 1984, p. 78)

This particular ethos that was first pioneered by Watson and Crick allows for, Halloran (1984) claims, today's "adventuresome, entrepreneurial, slightly irreverent spirit associated with the field of molecular biology and genetic engineering, a spirit that on its face strikes me as a recognizable offspring of the Watson-Crick ethos" (p. 79). Watson and Crick's seminal work has led to great developments in the fields of molecular biology and genetics since its time of publication. As part of this, it can be credited with opening the doors for an entire new industry: biotechnology. While I would not agree that Watson and Crick's ethos is the sole rhetorical cause for their rapid uptake in the sciences, this "spirit," or ethos, is noticeably

present in modern discourse surrounding genetic engineering and biotechnology, and perhaps further emphasized by the availability of new digital media.

In a response to Halloran's (1984) argument outlined above, Miller (1992) argues that it is not merely Watson and Crick's ethos that enabled their widespread acceptance and praise, but also the spatial and temporal openings of *kairos.* Miller successfully incorporates both the Bitzerian and Vatzian traditions of *kairos* to suggest that *kairoi* are both in place a priori to the rhetorical situation, passively waiting to be seized by the rhetor (in the Bitzerian tradition), but *kairoi* are also actively constructed by the rhetor through her fitting response. She explains that *kairos* "requires a dynamic interplay between objective and subjective, between opportunity as discerned and opportunity as defined" (Miller, 1992, p. 312). Building on the work of Thomas Kuhn (1996), Miller (1992) explains that Oswald Avery and Watson and Crick were working at two different ends of a paradigm shift, being presented with and constructing characteristically different *kairoi*, necessitating a different ethos for their responses:

> Avery's cautious tone was more appropriate for a period when anomalies were just beginning to be noticed against a framework of fairly solid expectations, and . . . Watson and Crick's confident gentility was more appropriate for a period when an explanatory synthesis was awaited. (p. 318)

Based on this interplay between *kairos* and ethos, or the opportunity enabling a rhetorical response and the suitability of that response, a study of ethos construction can provide insight into *kairos*, both what is offered in the context of the situation (in the Bitzerian sense) and what is actively constructed by the rhetor (in the Vatzian sense). Robert K. Merton (1979) famously outlined the components of scientific ethos through identifying the dominant institutional norms of the scientific community. In this sense, ethos is both an enabling and constraining component of building scientific knowledge (Prelli, 1989). Building on Merton's normative structure of science, Prelli (1989) argues, "The scientific *ethos* binds both technically and morally. It is technically binding because it prescribes efficient procedures for securing the extension of certified knowledge. It is morally binding because it is believed to assert what is right and good" (p. 48). Merton's set of institutional norms, Prelli argues, offers a set of rhetorical *topoi* on which to credit or discredit a scientist's work. Miller (1992), as discussed above, would add that *kairos* likewise provides a *topos* for developing a scientific argument.

While it is not my objective to outline how Merton's (1979) norms or the *topoi* they provide have shifted in recent years, there are some obvious and critical differences between the times Halloran (1984), Miller (1992), and Merton were writing, the rhetorical situation of Watson and Crick, and the current rhetorical landscape of the biological sciences and genetics. While Watson and Crick possibly foresaw the economic implications of their work, it has taken over half a century for the biotech industry to get on its feet, bringing with it a wealth of new ethical questions concerning the limits of the scientific enterprise and the patenting system. Given the controversial nature of many products of this new industry, speedy and transparent public communication has played a significant role in the industry. Since the time of Watson and Crick's publication, the development of digital media has increased the capability and importance of interacting with the interested lay public. Many communication scholars and rhetoricians have attempted to bring attention to the role of digital media in the rhetoric of science (e.g. Trench, 2008; Zappen, 2005), but we have only begun to scratch the surface of whether and how rhetoric changes with these new media. In this paper, I examine how Halloran and Miller's notions of ethos and *kairos* in the biosciences applies to the

biotechnology industry, and also how these concepts shift due to the affordances and constraints of digital media.

3. CASE STUDY: DENGUE, OXITEC, AND TRANSGENIC MOSQUITOES

Alternative pest management techniques like genetic pest management have received heightened attention from researchers due to the controversial nature of older pest control strategies like insecticides. In receiving more attention in the scientific sector, publics have, in turn, developed passionate attitudes (both for and against) the use of transgenic crops and insects. The first company to patent a transgenic mosquito is British company Oxitec. Oxitec's mosquito is used as a population suppression technique called Release of Insect with Dominant Lethal (RIDL), which Oxitec refers to as "sterile" male mosquitoes. These “sterile” mosquitoes are intended to be used to suppress the *Aedes aegypti* mosquito, the primary vector of dengue fever. Oxitec currently uses a complex website, informational videos, short films, Twitter, Facebook, and an emailed newsletter to communicate with English-speaking communities about their research and patented technology. The increasing availability and use of digital media, like those used by Oxitec, enable scientists and other organizations to side-step the journalist and have direct contact with many interested publics, ideally avoiding the problems scientists understand of the popularization process, like the idea of popularization being a “dirty mirror” to the “real” science (Bucchi, 2008). While digital media provide the facade of easy, quick, and transparent public communication, this assertion should be further challenged with empirical research.

This project investigates Oxitec's ethos construction across two digital media, including Twitter and an online video. By doing a comparative analysis across these media, this paper analyzes ethos appeals across media and their contribution to the construction of the *kairos* for Oxitec's technology. Building on the work of Halloran (1984) and Miller (1992), I argue that Oxitec's particular use of digital media, including an active Twitter feed and informational videos, enables the company to discursively construct their kairotic moment by amplifying a sense of fear and emergency surrounding dengue fever, simultaneously constructing their ethos as a group of scientists with the most fitting, and perhaps only, response to this pressing exigence of dengue fever.

3.1 Twitter

Oxitec addresses at least two audiences through their use of digital media: potential investors and an interested, English-speaking lay public. As these digital media are not the primary means of scholarly communication, scientists are not one of their primary audiences. Following Toulmin's (2003) argumentative structures, there are two claims asserted on Oxitec's Twitter profile, directed primarily to an audience of potential investors and an interested public. Two descriptions are offered on Oxitec's profile: 1) “[S]afe, sustainable control of dengue mosquitoes and agricultural pests” and 2) “Oxitec is a pioneer in controlling insects that spread disease and damage crops. Through world class science we have developed an innovative new solution to controlling harmful insect pests.” The claim in the first statement is that Oxitec creates “safe, sustainable control of dengue mosquitoes and agricultural pests.” The data for this claim are not explicit in this statement, but we can draw from statement 2 that Oxitec uses “world class science” to develop their technology. The warrant connecting these

data to the claim, again implicit, is that "world class science" creates safe, sustainable and innovative technologies.

The explicit claim of the second statement is that "Oxitec is a pioneer in controlling insects that spread disease and damage crops." The data for this claim are also made explicit: "[W]e have developed an innovative new solution to controlling harmful insect pests." The warrant for this statement (indicated by the preposition "through") is that innovative solutions and world class science make scientific pioneers.

Because these two arguments make claims based on values related to the scientific enterprise, we can draw the conclusion that these arguments are directed primarily toward potential investors. The primary interest for this audience is not necessarily dengue as a world health problem per se*,* but rather claims concerning the integrity of Oxitec and its technology. In other words, an audience of investors would be primarily interested in questions such as: Does it work? Is it based on credible and reliable science? Should I invest in Oxitec? A lay audience, on the other hand, would be primarily interested in Oxitec's contribution to solving a world health crisis, the environmental impacts of the technology, and possibly the capitalist interests of the company.

For this preliminary study and in order to understand how Oxitec constructs the ethos for their company to this audience of potential investors and a lay public on Twitter, I collected all tweets from October 12, 2012 to November 12, 2012. The sample collection totaled ninety-seven tweets. I then identified all hashtags in this sample of tweets in order to understand the issues Oxitec aligns itself with and what communities of people Oxitec connects with via Twitter.

A total of thirty-three tweets included #dengue, with this hashtag being by far the most common used by Oxitec. Another thirty-six mentioned dengue, but did not use the hashtag, making for a total of sixty-nine out of the collected ninety-seven tweets mentioning dengue. The second most common set of hashtags were those marking locations, such as #India and #Madeira. A total of eight tweets used thirteen different hashtags involving geographic locations. Only six other tweets used hashtags that were unclassifiable.[1]

For the purposes of comparison to the mention of dengue, only eight tweets mentioned "mosquito," "mosquitoes," "Aedes," or "Aedes aegypti." This suggests that Oxitec seeks to align itself with a humanitarian effort of combating dengue fever rather than the biotech industry. The use of the wide array of place-based hashtags emphasizes the applicability of their technology, the global nature of the problem, and therefore evokes a sense of emergency. Given the appeals to an audience of potential investors in the statements on Oxitec's profile, then this sense of emergency becomes a simultaneous appeal for funding. Establishing their clear exigence of dengue, and evoking the sense of emergency surrounding this exigence, gathers the attention of potential investors. However, this must be done continually given the nature of Twitter as a micro-blogging platform. Oxitec clearly fulfills this requirement given the high frequency of mentions of dengue.

After building their kairotic moment through establishing dengue as their exigence and evoking a strong sense of emergency around this health problem, the next step for Oxitec, in order to solidify an investor, is to construct an ethos which represents Oxitec as a credible, reliable, and ethical company and that their technology is the right approach to fill this niche.

1 These other hashtags include: #Bollywood, #OsborneSci, #climate-change, #death, #IfOnlyItWasFog, #Prop37, #radiation, and #crop

This step was not evident in Oxitec's Twitter feed, but is illustrated in their use of other, more static media such as the short films published on their website and the website itself.

3.2 Videos

Oxitec has published three short films on the home page of their website. These three films continue the work of the Twitter feed by using several rhetorical figures that make pathos appeals to further help construct the exigence for Oxitec's technology: the untreatable, uncontrollable, and unbearable "break-bone fever" or dengue fever. For this preliminary study, I focus on one of these videos, titled "Dengue Fever and the Aedes Aegypti Mosquito—An Oxitec Film" (Oxitec, 2012). This film, I found, is the most rhetorically interesting and serves as a fair representative of the other videos. Based on the content of this video, it appears that the primary audience for this film is an audience with little scientific knowledge, i.e., a lay public and some potential investors. Like Oxitec's Twitter feed, this video focuses strongly on dengue fever with pathos appeals. It also demonizes the *Aedes aegypti* mosquito through personification and presents Oxitec's technology as the most suitable, sustainable, and effective approach to combating the *Aedes* mosquito population and therefore dengue fever. This video differs notably from the Twitter feed in that it generates a sense of fear rather than emergency surrounding dengue.

The first part of this film includes several uses of anaphora, or repetitions of beginning elements similar in visual form. The video opens by showing three to four second clips from news broadcasts in succession, each one presumably from a different part of the world (Thailand, Latin America, and the United States). Each clip shows a newscaster describing the disease and warning viewers of a "dengue outbreak" (with the words "dengue" or "dengue outbreak" repeating in each clip). Three of four news clips show a newscaster seated and speaking directly into the camera to report on the illness, and two of the four clips show the word "dengue" and a photograph of a mosquito; the other two clips show images of citizens while the newscaster discusses dengue, and in one of these two clips the citizens are presumably sick with dengue. The repetition of similar news frames stresses both the severity and the global nature of this illness (similar to the use of place-based hashtags in the Twitter feed), creating an emotional appeal that draws on the audience's sympathy for others. At the same time, this repetition stresses the immediate need for a solution like what Oxitec provides.

Another instance of visual anaphora appears immediately following the series of news clips. The video focuses on a mosquito feeding on human skin, while individual words fly in from either side of the frame, each in the same font and color, but in varying size. These words describe the disease and symptoms as the narrator of the film describes the horrors of dengue. Again, the repetition of similar words, designed with a similar style and animated with the same motion, stress the severity of the illness, making another appeal of pathos and contributing to Oxitec's ethos by creating a sense of immediacy surrounding dengue and a need for a solution.

Later in the same video, aural anaphora is used by Prof. Paul Reiter, "Global Dengue Expert," who is shown describing the movement of *Aedes aegypti* and the movement of the virus: "This is a *jungle* mosquito, and a *jungle* virus, that has moved to the urban *jungle*, and we've helped it by essentially transporting it all over the world." This specific use of anaphora differs slightly from those examples above in that it does not appeal directly to pathos, but makes a direct attack against what we might consider the ethos of the *Aedes aegypti* mosquito

by emphasizing its status as an outsider, not an insect which is native to the natural environment of the areas which suffer from dengue virus. What this attack does, however, is increase the credibility of Oxitec and help justify their research by framing this mosquito as an intruder, not a native to its environment.

Anaphora is used again just before moving into the major portion of the video, an interview with Haedes and Aegypta (these names are an example of *paronomasia*, or pun), a male and female mosquito who are the culprits for the spread of dengue. Just before moving into the interview, several newspaper headlines about dengue, presumably torn from both Spanish and English newspapers, are laid on top of one another in succession, with the final newspaper clipping being a photograph of the mosquitoes Haedes and Aegypta (also an example of visual climax). This visual anaphora of the repeated torn newspaper headlines serves as another pathos appeal by, like the repeated news broadcast frames, stressing the global nature of the disease, the immediacy of the problem, and, therefore, the need for a solution like what Oxitec has developed.

The interviews with Haedes and Agypta are most obviously an example of personification. Both mosquitoes carry similar features to the *Aedes agypti* mosquito (e.g. striped legs, larger female head, etc.), but in exaggerated form. The video opens with the narrator thanking the mosquitoes for agreeing to be filmed. Agypta, the female mosquito replies, “Not at all, darling. Come a little closer, I won't bite.” Agypta puts excessive stress on “bite” and lets out a loud laugh that a user might characterize as evil. After the narrator asks Agypta about her home, she replies, “Yes, isn't it perfect, darling. I just moved from the plant part in the hallway to be closer to my delicious family.” Agypta slows down considerably and slightly lowers the pitch of her voice when she begins the phrase “to be closer to my delicious family.” She also puts extra emphasis on the word “delicious.” At the end of this response she also lets out another similar laugh to the earlier laugh that we might characterize as evil. These features of personification in this film create what we might consider to be an ethos for the mosquito itself, as the evil, malicious culprit of transmitting the dengue virus. This personification and negative ethos construction for the mosquito help to further the appeal to fear and boost the credibility of Oxitec as working to fulfill a great humanitarian cause.

Agypta continues, “Course Haed' here doesn't partake. He's a 'veggie.'” Redirecting her commentary towards Haedes, she continues, “Honestly, you call yourself a mosquito.” Haedes at this point attempts to interject, but Agypta interrupts him, “Haedes just follows me around. Its the only thing he's good at.” This interaction has greater meaning once the viewer learns, with a wink from Haedes at the end of the video, that he is an Oxitec transgenic mosquito. This interaction represents the Oxitec male mosquito as passive, having no impact on the human population (given that he's a “veggie”), and operating incognito. The latter point is emphasized further when an angered Agypta, after learning about Oxitec's mosquito, insists that she will be able to tell the difference between the natural males and the Oxitec strain. The narrator and the viewer know, however, that she cannot, since Haedes is an Oxitec mosquito himself. The conclusion a viewer may jump to is that if a natural mosquito cannot tell the difference between the wild and Oxitec strains, then the transgenic mosquito must have minimal environmental impact.

Haedes himself (only after being ordered by Agypta) explains that people have been using fogs for fifty years as an attempt to get rid of them, but this strategy, Haedes explains, kills other insects too and, “we're getting used to it now. Besides, people don't like fogging their own home, so its safe in here.” Then, the narrator asks if they have heard of the Oxitec

method, and after Agypta indicates not, the narrator leads into a segment where Hadyen Parry, the Oxitec CEO, discusses the Oxitec method. In this segment, a female scientist is depicted focusing closely on her work under a microscope injecting embryos. A racially diverse group of Oxitec scientists are also shown sitting around a conference table deep in discussion. These images of scientists go directly against stereotypes often found in television media, which are typically "nerdy," elitist, and anti-social white males, and of foreign descent (Long et al., 2010; Long & Steinke, 1996). This casts Oxitec as a selfless, disinterested in economic gains, and cautious group of scientists, driving a wedge between these scientists and the stereotype that a viewer might evoke. In other words, this suggests, through clever use of visuals, an "imagined expert" (Blok, Jensen, & Kaltoft, 2008) for viewers to associate with the Oxitec scientists.

Parry discusses how the Oxitec mosquitoes carry "specific DNA, so that when they mate with females, the offspring do not survive." Later, Parry states that this method is "birth control for insects." What is perhaps most interesting in this segment of the video is the lack of use of terminology such as "transgenic," "genetic engineering," and "genetic modification." Parry only states that Oxitec has "developed a strain of mosquito" but does not mention by what method. Parry compares it only to birth control, which is a mostly accepted practice for humans in industrialized nations. This absence of controversial scientific terminology, while it would accurately describe the Oxitec process, seems to be an attempt to disassociate Oxitec with these controversial methods, and present their method as neutral as possible.

Comparing this representation of the Oxitec scientists to the appeals of fear generated earlier in the video, Oxitec is presented as a calm, sensible, sustainable solution to the frightful problem of dengue fever. If one intended audience for this video is an interested lay public, one might conclude that the purpose of this structure of fear generation, then calm and sensible solution, is to quell any controversial thoughts surrounding Oxitec scientists and their method. This is, however, dangerous logic, considering that the video only presents one other method, insecticides, as an alternative, when there are many biological, mechanical, and integrated pest management approaches for controlling *Aedes aegypti.* This uses a logical flaw of presenting a complex problem as a dichotomous choice.

This video operates differently from the Oxitec Twitter feed in order to accomplish similar goals. Where Twitter uses repetition and emphasis on dengue to generate a sense of emergency, this video uses rhetorical figures of repetition to generate a sense of fear surrounding dengue. Both these appeals function similarly by establishing a pressing exigence for the Oxitec technology. Through this video, Oxitec builds its ethos through constructing a negative ethos for the personified *Aedes aegypti* mosquito, careful choosing of uncontroversial terminology like "birth control" rather than "genetically engineered" or "transgenic" to describe their mosquito, and presenting socially engaged and diverse scientists that go against the common scientist stereotype presented in television media. This completes the work of the Oxitec Twitter feed by showing that not only is this an emergency situation, it is a fearful situation, and Oxitec provides the credible, sustainable, and trustworthy solution. For an audience of investors, this completes an appeal for funding. For an interested lay audience, this attempts to quell any controversial discourse surrounding the approach and boost the credibility of Oxitec.

4. CONCLUSION

To return to the metaphor evoked in the introduction, manufacturing, I propose that Oxitec's use of digital media to generate a sense of fear and emergency surrounding dengue fever enables them to manufacture a *kairos* within the public realm that is markedly different from that which is presented in the literature on neglected tropical diseases, including dengue fever. Ceccarelli (2011) defines a manufactured scientific controversy as an event where "an arguer announces that there is an ongoing scientific debate in the technical sphere about a matter for which there is actually an overwhelming scientific consensus" (p. 196). To adapt her definition to the concept of a manufactured *kairos,* an opportunity may be considered to be manufactured in the public realm when that opportunity, as produced by the rhetor, is inconsistent with the technical niche to which it claims to fill. To be clear, I do not wish to suggest that dengue fever is not an illness of great detrimental impact and global concern, but I am merely pointing to potential inconsistencies between the scientific literature on dengue and pest management and the way in which Oxitec communicates via popular media.

Dengue fever is often included within a group of infectious diseases that are highly endemic in tropical regions and regions of severe poverty in Africa, Asia, and the Americas. Collectively, this group is referred to as "neglected tropical diseases." These diseases disproportionately affect those of lower socio-economic status, and while generally having a low-mortality rate, cause high-morbidity (Hotez, 2011). When considered collectively, neglected tropical diseases carry a greater burden than each of the "big three" (malaria, HIV/AIDS, and tuberculosis), but are often given short shrift in research and funding (Hotez, 2009). In addition, it is thought that if some or all of these neglected tropical diseases are treated and eliminated, citizens in the endemic areas would also see a decrease in malaria, HIV/AIDS and tuberculosis (Hotez & Pecoul, 2010). Dengue, specifically, is considered one of the more important neglected tropical diseases, behind hookworm infection, other soil-transmitted helminth infections, and Chagas disease (Hotez, Bottazzi, Franco-Paredes, Ault, & Periago, 2008).

Given this definitional context of neglected tropical diseases, there are a few troubling aspects of Oxitec's public communication strategy, as I have presented it above. Oxitec uses these media of film and Twitter to bring attention to and amplify their exigence of dengue, construct this exigence as an emergency situation, and build their ethos as the ideal candidate to fill the niche. This particular framing of the situation, however, does not give due credit to the economic impact of these diseases and the health impact on other, more fatal, diseases like malaria. The simplification of the complex economic, societal, and biological impact of dengue, as a neglected tropical disease, is surprising given how this disease is understood in the scientific literature. Less surprising, however, is the omission of other potential control strategies for the *aedes Aegypti* mosquito, such as population-replacement gene-drive systems like Wolbachia (Sinkins & Gould, 2006) and cultural control techniques, given Oxitec's economic interest in pursuing potential customers and investors in their specific technology.

These accessible new media allow messages to be directed toward both an interested lay audience and potential investors, which were once clearly divided forums, with differing exigencies and differing messages. This fulfills the prophecy outlined by Halloran (1984) in his work on Watson and Crick's ethos and the birth of molecular biology. According to Halloran (1984), the industry that spawned from Watson and Crick's work on the molecular structure of DNA has demonstrated a new kind of ethos, an "adventuresome, entrepreneurial, slightly irreverent spirit" (p. 79). However, as I have attempted to illustrate here through the Oxitec

case, this "spirit" can not only be credited to Watson and Crick, but also to the affordances and constraints offered by digital media.

Miller (1992) criticized Halloran's argument by resisting the claim that it was Watson and Crick's ethos which contributed to their success, but that it was their *kairos* that necessitated this ethos, making it the most fitting response. In Miller's definition of *kairos,* she claims that one dimension includes the "changing quality of moments in time, moments that constitute the contexts for scientific discourse" (p. 314). I would add to this argument that digital media have heightened this dynamic aspect of *kairos*, and necessitated that scientific industry actively construct the *kairos* for their work in order to increase their chances of positive reception by the public and interest from investors.

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